

CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-26

March 7, 1977

1. Name of fault: Arroyo Parida fault (eastern segment) and Santa Ana fault.
2. Location of fault: Ojai, Matilija and White Ledge Peak 7.5' quadrangles, Ventura County; this fault extends westward into Santa Barbara County (see FER-3).
3. Reason for evaluation: Part of a 10-year program; zoned in the Ventura County Seismic and Safety Element.
 - a) Buchanan, J.M., Ziony, J.I., and Castle, R.O., 1973, Recent elevation changes across part of the Transverse Ranges near Ventura, California: Geological Society of America, Abstracts with Programs, v. 5, no. 1, p. 17.
 - b) Chauvel, J.P., 1958, The Geology of the Arroyo Parida fault, Santa Barbara and Ventura Counties, California: Unpublished M.A. thesis, University of California, Los Angeles, 62 p., geologic map scale 1:24,000.
 - c) Cilweck, B.A., 1976, personal communication.
 - d) Dibblee, T.W., 1947, Unpublished geologic map of Ventura quadrangle: U.S. Geological Survey, scale 1:62,500.
 - e) Jennings, C.W., 1975, Fault map of California with locations of volcanoes, thermal springs, and thermal wells: California Division of Mines and Geology, California Geologic Data Map Series, Map no. 1, scale 1:750,000.

- f) Jennings, C.W., and Strand, R.G., 1969, Geologic map of California, Los Angeles sheet: California Division of Mines and Geology, scale 1:250,000.
- g) Nichols, D.R., October 1974, Surface faulting in Seismic and Safety Elements of the Resource's Plan and Program: Ventura County Planning Department, section II, p. 1-35, plate 1.
- h) Putnam, W.C., May 1942, Geomorphology of the Ventura region, California: Geological Society of America Bulletin, v. 53, p. 691-754.
- i) Turner, J.M., 1971, Geohydrology of the Ventura River system, ground-water hydrology, Ventura County: Ventura County Department of Public Works, Flood Control District, Water Resources Management Study, 31 p.
- j) Weber, F.H., Jr., Cleveland, G.B., Kahle, J.E., Kiessling, E.F., Miller, R.V., Mills, M.F., Morton, D.M., and Cilweck, B.A., 1973, Geology and mineral resources study of southern Ventura County, California: California Division of Mines and Geology Preliminary Report 14, 102 p., map scale 1:48,000.
- k) Weber, F.H., Jr., Kiessling, E.W., Sprotte, E.C., Johnson, J.A., Sherburne, R.W., and Cleveland, G.B., 1975, Seismic hazards study of Ventura County, California: California Division of Mines and Geology, Open File Report 76-5LA, 396 p., 9 plates, map scale 1:48,000.
- l) Ziony, J.I., Wentworth, C.M., Buchanan-Banks, J.M., and Wagner, H.C., 1974, Preliminary map showing recency of faulting in coastal southern California: U.S. Geological Survey, Miscellaneous Field Studies Map, MF-585, 15 p., map scale 1:250,000, 3 pl.

5. Summary of available information:

The Arroyo Parida and Santa Ana faults are zoned as a secondary fault hazard in the Ventura County Seismic and Safety Element (Nichols, 1974). However, it should be noted that Nichols zoned nearly every fault shown by Weber, et al. (1973), as secondary fault hazards. Nichols considered the Arroyo Parida and Santa Ana faults to be a single fault. Nichols noted that "Evidence as to direction of dip is conflicting." He also noted that no associated earthquake activity has been recorded but that the fault apparently forms a ground water barrier beneath the Ventura River. Using this ground water barrier as his basis, Nichols considered the Arroyo Parida-Santa Ana fault as potentially active. Turner (1971) and Weber, et al. (1975) also confirm this water barrier (see plate 2), however Turner (plate 1 of his report) shows the barrier as entirely in late Pleistocene deposits and not cutting Holocene deposits.

Putnam (1942) is the earliest reference available on the Santa Ana fault. He notes that the Santa Ana fault forms a fault-line scarp between the Upper Ojai Valley and the Ojai Valley. To the east, the Santa Ana fault is overridden by the San Cayetano fault. Putnam (p. 706) notes "Terrace gravel east of the (Ventura River) obscures the continuation of the fault." He (p. 707 and 720) concluded that the Santa Ana fault was a south-dipping fault that had had "renewed" activity in the late Pleistocene.

Dibblee (1947) noted no units younger than Sespe Formation (Oligocene) to be truncated by the Arroyo Parida fault. He identified the eastern segment of the Arroyo Parida fault, as mapped by others in the Matilija quadrangle (plate 3), as an anticlinal axis.

Weber, et al. (1975), describes the Arroyo^g Parida-Santa Ana fault as a wide zone of several steeply^g dipping faults. These faults are described (p. 198) as "strong faults with apparently very youthful movement." In table 3, they describe the fault as having moved during the Holocene noting:

"Strong, well developed geomorphic features of faulting suggest youthful activity; north-facing scarp in older alluvial gravels along Villanova Road implies at least 200 feet of displacement of gravels; also deflection of Poplin and Coyote Creeks; very youthful scarps occur along the side of Ojai Valley. Water-bearing, older and younger alluvial gravels in Ventura River are 200 feet thick north of fault and 65 feet thick to the south (Turner, 1971), implying relatively recent displacement. A second fault, affecting ground water-bearing alluvium of the Ventura River, was mapped by Montgomery Research, Inc. (1972) to the north of the Santa Ana. Some epicenters of magnitude 3-4 are crudely aligned along this zone."

However, again it is emphasized that Turner shows this displacement as entirely within late Pleistocene deposits. The "youthful scarps" are in late Quaternary units and are not conclusive evidence of Holocene faulting. Neither is the ground water barrier referred to by Weber, et al.

Jennings (1975) shows the Arroyo Parida and Santa Ana faults as Quaternary (after Weber, et al. 1973). Ziony, et al (1974) depict the faults as late Quaternary in age, noting that late Quaternary units are cut by the faults, and also noting the existence of a fault produced feature in Pleistocene deposits.

Perhaps the most detailed work along the Arroyo Parida fault was done by Chauvel (1958). Chauvel's field area extended approximately from the Ventura River westward into Santa Barbara County. In Santa Ana Valley, the fault is concealed under a thick sequence of Pleistocene(?) conglomerates (see plate 3). He described the fault as a north dipping fault having one mile of left-lateral strike-slip separation and a

small dip-slip component, south block always up relative to the north block. This is consistent with the ground water data of Turner (1971).

He describes the fault as a zone 150 to 200 feet wide north of Laguna Ranch (near the county line). Measured dips along the fault range from 55° to 75° northward. He does note that the surface trace north of Laguna Ridge indicates that the fault locally dips to the south. Chauvel postulates a dip-slip component of 700 feet to 2700 feet total offset. He noted that some of the streams are offset left-laterally while others are not offset at all (but these streams may be young streams, he says). Further evidence for strike-slip offset include drag folds and structural relationships.

Chauvel stated that he could not find the Arroyo Parida fault east of the Santa Ana Creek, but he concluded (based primarily on physiographic evidence) that it continues eastward and is "related to or continuous with" the Santa Ana fault. Chauvel (p. 55) noted that the Arroyo Parida fault may be the product of a mid-Pleistocene orogeny since terraces "have been folded, tilted, and faulted."

About the geomorphology Chauvel noted (p. 52-53, after M.L. Hill, 1932, p. 543):

"The faulting is apparently not reflected directly in the topography. There are scarps without faults and faults without scarps. Where scarps are accompanied by faults they have fault-line characteristics which depend directly on differential erosion. In spite of the recency of faulting, the lack of fault scarps is attributed to rapid erosion and to the subordination of vertical displacement. Such topographic expression is unfavorable to the physiographic method of fault mapping."

Chauvel does note, however, that except for a 1 1/2 mile stretch of fault near Laguna Ranch, the Arroyo Parida fault usually occupies a

topographic low. Chauvel's map shows that the fault does not cut older alluvium (Pleistocene) in the Santa Ana Valley. The youngest faulted unit shown is the Sespe Formation.

Cilweck (personal communication, 1976) attempted, without success, to trench across the Arroyo Parida-Santa Ana fault on the site of the county jail. He noted that large (5-6 feet in diameter) boulders in the fan deposits hindered the investigation. He was not confident whether the fault either did or did not cross the site.

Finally, Buchanan, et al. (1973) attempted to determine whether the Arroyo Parida fault was being stressed. They noted that differential elevation changes could not be detected by first order leveling across the Arroyo Parida fault along Highway 33. They state that the fault "...exhibits evidence of late Pleistocene movements but...Holocene displacements are unknown."

6. Interpretation of air photos:

The various aerial photographs noted in table 1 were viewed stereoscopically. Photos "AXI" are U.S. Department of Agriculture air photos. Those coded "C" are Fairchild air photos from the Whittier Collection.

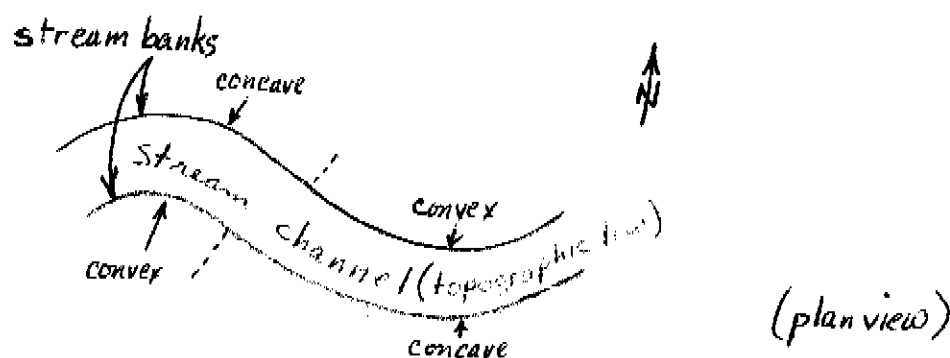
Table 1. Air photos utilized in the compilation of data for FER-26.

<u>Flight</u>	<u>numbers</u>	<u>date flown</u>	<u>scale</u>
AXI 4k	8,9,50-53,67,68	1953	1:24,000
AXI 5k	4-6, 12, 13	1953	1:24,000
AXI 7k	133, 134	1953	1:24,000
C5609	6,7,17-19,29,30,42,43	1939	1:14,400

Features noted are plotted on plates 2, 3, and 4. No fault produced features were noted on the northern branch of Weber, et al., 1975 (which supposedly passes through Rancho Matilija (see plate 3).

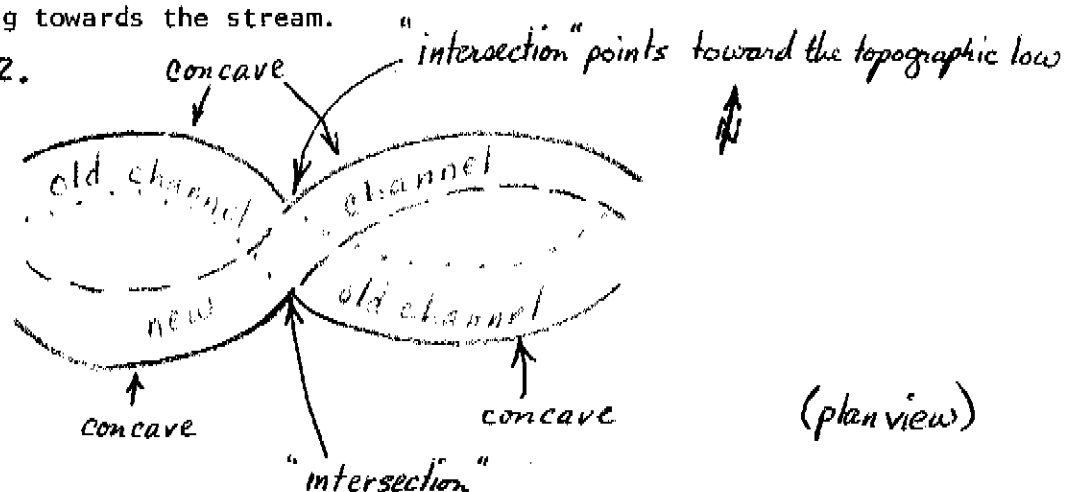
Two features noted on air photos merit special mention. The first lies between Ojai and Black Mountain (see plate 4). This scarp in late Pleistocene alluvium could be explained as an old channel meander scar. However, the configuration of the scarp differs from that expected of a channel scar. Stream banks are either concave or convex (fig. 1).

Figure 1.



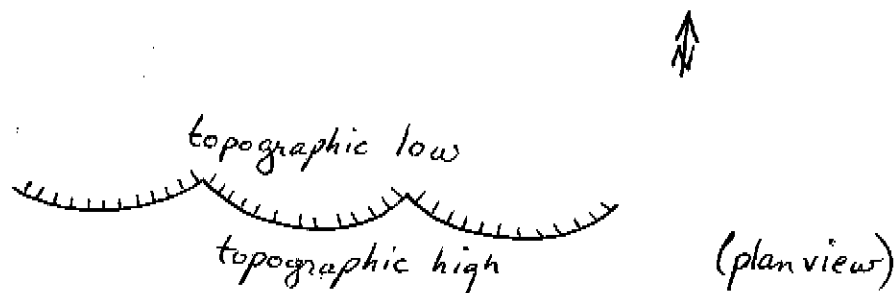
As the stream changes course, the stream banks tend to become primarily concave (figure 2) with the "intersections" of the old and new banks pointing towards the stream.

Figure 2.



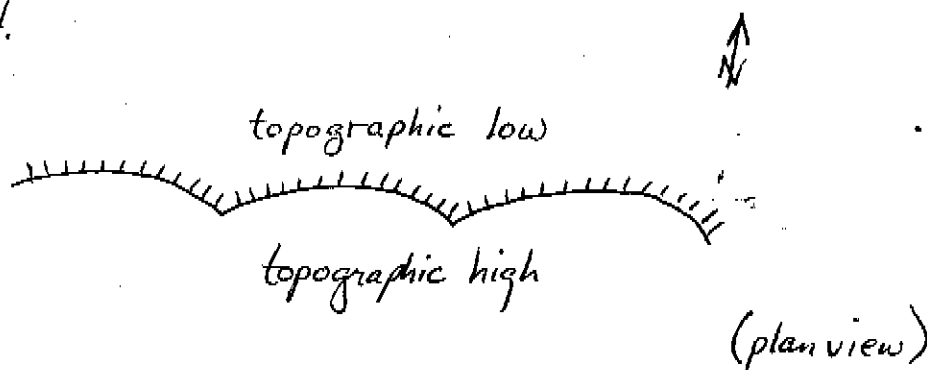
Thus, if only one bank remained, one could expect to find a "scarp" in this "concave" configuration (figure 3).

Figure 3.



But in reality, the escarpment noted on plate 4 is "convex" with the "intersections" pointing away from the topographic low (figure 4).

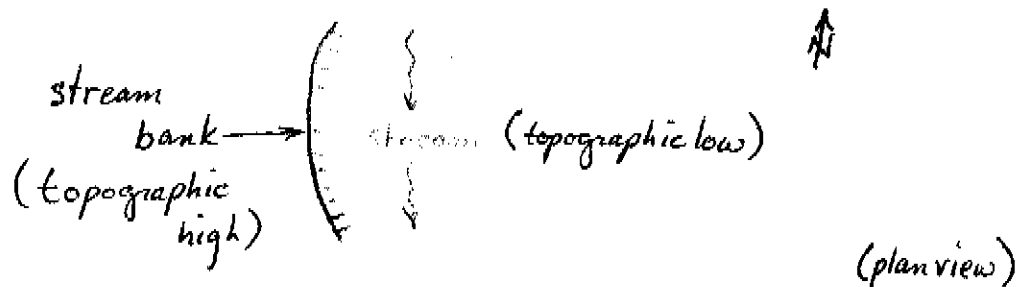
Figure 4.



Thus, one can conclude that this escarpment is due to other than stream erosion. One possibility is that this feature could be the result of a very low angle thrust fault, up on the south (which is at least the correct sense of movement for both the Arroyo Parida and Santa Ana faults). [TCS NOTE: I must admit that I have not reviewed these photos since developing this hypothesis, and I am not certain that anyone else looking at these photos would come to the same conclusions. These photos should be looked at again to determine whether this hypothesis really has merit.]

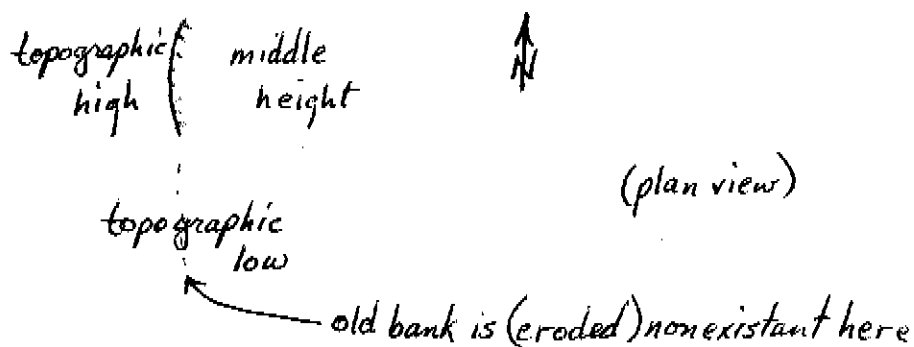
The second feature is located near Henderson Field in the Matilija quadrangle (plate 3). This feature is in the same location as that which Ziony, et al. (1974) noted as evidence for late Quaternary offset. This feature is actually two crossing escarpments. Assume that the north-south trending escarpment is probably an old stream bank (fig. 5).

Figure 5.



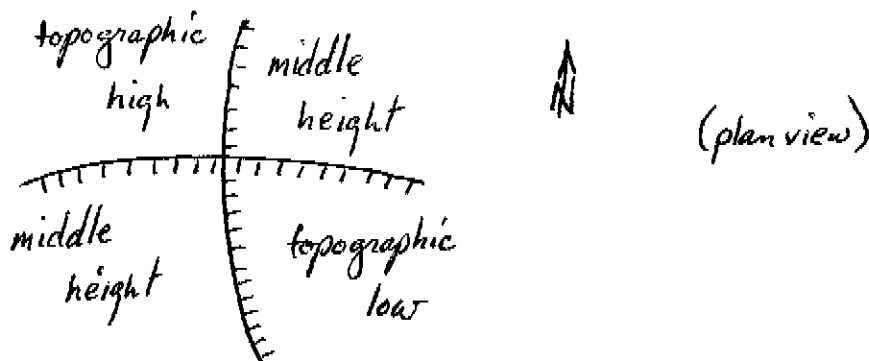
If the stream changes course, running at right angles to the first flow, then the (south) segment of the old bank would be eroded away (figure 6).

Figure 6.



However, the south segment of the old stream bank was not obliterated, therefore, the east-west scarp must be due to other causes (such as faulting) (see figure 7).

Figure 7.



Unfortunately, it is impossible (by this deductive reasoning) to determine which scarp was produced first and, therefore, which scarp is due to other causes (faulting). However, this feature lies along the trace of the east-west trending Arroyo Parida and Santa Ana faults and thus, may be the surface expression of these faults. One problem, however, lies in the fact that the northern block is elevated with respect to the southern block and thus, indicates movement in the opposite direction of all other data. For a further description of this feature, see item 7.

All of the topographic features noted were in either late Pleistocene, late Quaternary (non-specific), or older units and, therefore, cannot be assigned any age younger than late Quaternary.

7. Field observations:

Time did not permit a detailed examination of the Arroyo Parida and Santa Ana faults. I spent about 4 hours on January 11, 1977 examining several specific sites and making a general reconnaissance along the fault. West of Lake Casitas, the fault is almost entirely within the Sespe Formation. No obvious faults were noted in the road cuts, near the mapped trace but about 30 feet of road fill covers the fault where State Highway 150 supposedly crosses the fault. If the fault does pass through this area, then it must be confined to a zone less than about 200 feet wide. Since the Sespe Formation is a weather-resistant unit, one would expect that the fault should be well-defined within the unit.

I was unable to see the fault in the banks of the Ventura River channel. However, these banks are rather heavily vegetated.

Along Rice Road, I noted the east-west trending scarp discussed earlier ("second feature" in Item 6). A driveway obscured the base of the scarp, however, I did note a change in the general character of the deposits. North of the driveway numerous cobbles were noted in a cut. South of the driveway no cobbles were noted in the cut (however, this cut was only 12 inches high south of the driveway). The scarp was about 2 to 3 feet high where it crossed the road, and sloped about 10° to the south. Along State Highway 33, I was able to observe a slight escarpment behind the Casitas Water District Pumping Plant. However, it appears that the north-south trending scarp might have been quarried in part, and that the east-west trending scarp could be man modified to the east of this north-south trending scarp. An escarpment probably the continuation of the scarp observed along Rice Road was quite evident immediately west of the north-south trending scarp. However, again no actual offsets were observed.

The area along Villanova Road, along which the Santa Ana fault is mapped (plate 3), is highly modified. However, I was not able to observe any faults in the few road cuts that were available.

8. Conclusions:

The Arroyo Parida and Santa Ana faults appear to offset late Pleistocene units, however, there is no conclusive evidence to suggest that these faults have been active during the Holocene. Thus, the faults can only be classified as late Pleistocene faults and are not sufficiently active. The faults may be well-defined in some locations, but I am not able to state conclusively that I was able to observe these faults.

9. Recommendations:

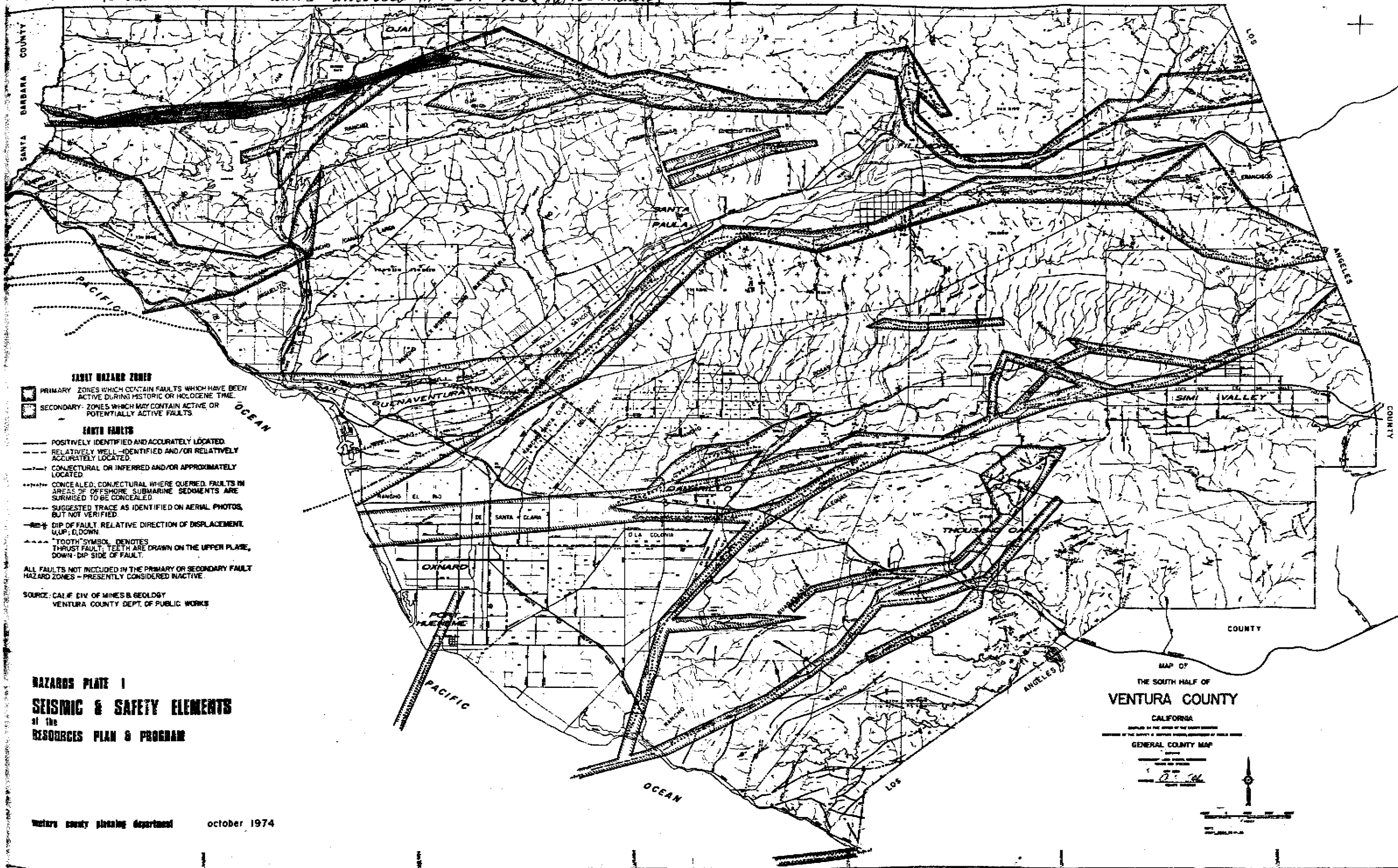
Based on the data summarized in this report, and on the criteria presently applied, the Arroyo Parida and Santa Ana faults should not be zoned at this time.

10. Investigating geologist's name; date:

Theodore C. Smith
Assistant Geologist
March 7, 1977

*I agree with
recommendation.
GWS
4/4/77*

Plate 1. General location of faults discussed in FER-26 (Pattor Nichols, 1974)



FAULT HAZARD ZONES

PRIMARY: ZONES WHICH CONTAIN FAULTS WHICH HAVE BEEN ACTIVE DURING HISTORIC OR HOLOCENE TIME.

SECONDARY: ZONES WHICH MAY CONTAIN ACTIVE OR POTENTIALLY ACTIVE FAULTS.

EARTH FAULTS

— POSITIVELY IDENTIFIED AND ACCURATELY LOCATED.

- - - RELATIVELY WELL-IDENTIFIED AND/OR RELATIVELY ACCURATELY LOCATED.

- · - CONJECTURAL OR INFERRED AND/OR APPROXIMATELY LOCATED.

· · · CONCEALED; CONJECTURAL WHERE QUERIED. FAULTS IN AREAS OF OFFSHORE, SUBMARINE SEDIMENTS ARE SURMISED TO BE CONCEALED.

- · - SUGGESTED TRACE AS IDENTIFIED ON AERIAL PHOTOS, BUT NOT VERIFIED.

— DIP OF FAULT, RELATIVE DIRECTION OF DISPLACEMENT, U, UP; D, DOWN.

— "TOOTH" SYMBOL, DENOTES THRUST FAULT, TEETH ARE DRAWN ON THE UPPER PLANE, DOWN - DIP SIDE OF FAULT.

ALL FAULTS NOT INCLUDED IN THE PRIMARY OR SECONDARY FAULT HAZARD ZONES - PRESENTLY CONSIDERED INACTIVE.

SOURCE: CALIF. DIV. OF MINES & GEOLOGY
VENTURA COUNTY DEPT. OF PUBLIC WORKS

HAZARDS PLATE I

SEISMIC & SAFETY ELEMENTS

of the

RESOURCES PLAN & PROGRAM

MAP OF
THE SOUTH HALF OF
VENTURA COUNTY
CALIFORNIA

SHOWN IN THE AREA OF THE COUNTY BOUNDARY
BORDERED BY THE COUNTY OF KERN, COUNTY OF LOS ANGELES, AND COUNTY OF SAN BERNARDINO.

GENERAL COUNTY MAP

